



Figure 5-3. Regional Population Distribution
Note the continued population density in the South Coast Region.

Additional Conservation as a Result of the CALFED Program

Opportunities exist to further reduce indoor use below the 60 gpcd assumed under the No Action condition to levels as low as 55 gpcd or even 50.

This amount is still ample for continuation of existing lifestyle habits, such as daily showers, dishwashers, laundry, and use of water softeners, and will result in reductions in future demand statewide. This additional reduction can be obtained through measures such as more aggressive interior water audits; use of incentive programs to retrofit residences with low-water-use fixtures; conversion to low-water-use shower heads; and gradual conversion to very efficient appliances in the majority of households, such as horizontal-axis washing machines. (This technology is new to the United States but widely used in other parts of the world, such as Europe and the Middle East.) Estimates also assume the development of additional technologies and incentive programs that go beyond BMPs currently suggested in the Urban MOU. Lifestyle habits do not need to change to allow these gains to occur. To achieve these levels, however, will require strong incentive programs and public outreach to gain widespread acceptance and implementation.

For purposes of the Water Use Efficiency Program, indoor residential water use rates are assumed to reach 55 gpcd statewide. Again, this value is supported by information developed by WaterWiser in its 1998 end-use study. In graphs published on their web page, WaterWiser indicates that the typical family home could reduce its indoor use rates to 52 gpcd with full implementation of available conservation measures (WaterWiser 1998). CALFED believes that this reduction can be achieved by large sectors of the population by 2020 and feels confident that using 55 gpcd represents a realistically achievable level of indoor residential water conservation.

Estimated savings resulting from this indoor use reduction were calculated in the same manner as the No Action Alternative savings. The incremental difference between the No Action Alternative condition of 60 gpcd and CALFED's assumed level of 55 gpcd is multiplied by the projected 2020 population for each region (see Figure 5-4). The estimated savings are shown under each regional description provided later in this section.

5.4.2 URBAN LANDSCAPE CONSERVATION

Outdoor water use for landscape irrigation varies widely across California. In fact, this portion of urban water use is probably the most varied of all urban water use factors. In hot inland areas, average outdoor water use, primarily from landscaping evapotranspiration, can be as high as 60% of the total residential use. Conversely, in cooler coastal areas, outdoor use can be as low as 30% of total residential use. Effective precipitation occurring in coastal areas, either as rain or dew from fog, also acts to reduce coastal area outdoor use.

There is little empirical data that currently exists which provides sufficient information on statewide landscape acres and water use. Current estimates of state-wide urban acreage have been developed by DWR and indicate about 1 million acres of urban areas are part of an irrigated landscape. A large majority occurs in the South Coast Region, which includes the area from greater Los Angeles to San Diego. It is anticipated that as the state's population increases, so will the residential landscape acreage. However, data regarding current acreage amounts and relationships to potential increases are not readily available. For purposes of the CALFED Program, the 1 million acre estimate has been distributed, statewide based initially on population. Values were adjusted to account for assumed regional differences, such as coastal areas generally characterized by smaller yards and more people per household than inland areas (for example, San Francisco versus Sacramento) and thus less total acreage per person. Estimated current and projected acreage values are shown in Table 5-3. Values for 2020 were projected by increasing current estimates by the ratio of a region's forecasted population to its existing population (population information is presented for each urban zone later in this section). Regional population estimates are displayed in Figure 5-4.

Table 5-3. Urban Landscaped Area (acres)

REGION ¹	1995 ESTIMATED	2020 FORECAST
Sacramento River	100,000	145,000
Eastside San Joaquin River	65,000	120,000
Tulare Lake	70,000	130,000
San Francisco Bay	155,000	180,000
Central Coast	35,000	50,000
South Coast	480,000	650,000
Colorado River	<u>35,000</u>	<u>75,000</u>
Total	940,000²	1,350,000

¹ Refer to Chapter 3 for information regarding the PSAs that comprise each CALFED region.

² Values shown in the table do not add to 1 million acres because some areas of the state, like the north coast and eastern side of the Sierra Mountains, are outside the CALFED Program geographic scope but are included in the estimated statewide value of 1 million.

Irrigation Needs of Urban Landscapes

Each acre of urban irrigated landscape represents a demand for water. The primary element in the determination of this demand is the evapotranspiration rate (ET). ET is the amount of water evaporated by the soil (evaporation) and used by the plants (transpiration) over a given period of time. Reference evapotranspiration (ET_o) is a measurement of a standard crop (well watered, cool-season grass, 4-6 inches tall) under standard conditions.

ET_o usually is determined daily for a specific area, using climatological instruments at specific locations. Daily values are cumulated to form average monthly or annual values. Although the specific ET_o for every location is not available, average ET_o values for most regions of the state are fairly well accepted and used for planning and analysis. The values in Table 5-4, obtained from DWR, were assumed by CALFED to aid in conservation calculations.

*Table 5-4. Reference ET_o Values Assumed
for Urban Regions*

REGION ¹	REFERENCE ET _o
Sacramento River	4.2 (feet/year)
Eastside San Joaquin River	4.3
Tulare Lake	4.3
San Francisco Bay	3.3
Central Coast	2.8
South Coast	4.0
Colorado River	6.0

Note:

These values were provided by DWR staff at the Division of Planning and Local Assistance. They are similar to values used by DWR in the Bulletin 160-98 Public Draft (DWR 1998).

¹Refer to Chapter 3 for information regarding the PSAs that comprise each CALFED region.

Once the ET_o is determined for an area, three other factors must be considered:

- The size of the area to be irrigated
- The plants within the area
- The efficiency of the irrigation system

The amount of water a plant needs in relation to the standard measurement of ET_o varies, depending on the physiology of the plant. In general, cool-season grasses like Kentucky Bluegrass and Fescue, require 80% of ET_o while warm-season grasses like Bermuda grass require 60% of ET_o. Trees, shrubs, and groundcovers in the moderate water-using category (close to 80% of the commonly grown plants in California) require 40-60% of ET_o. Low water-using plants range from 0 to 30% of ET_o.

The typical California residential landscape (also the majority of the urban landscape acreage), consists of a lawn, some shrubs or other smaller plants, and a few trees. This tends to be the case whether in the Bay Area or Palm Springs, Bakersfield, or Sacramento. Recent landscaping trends in some areas of the state include planting water-efficient landscapes, or xeriscape, a term given to the use of more low-water-using plants in combination with more efficient landscape designs and irrigation systems. These landscapes can use far less water than the more lawn-intensive landscapes but are slow to be adopted in some areas of the state.

The last factor in determining landscape water needs is the efficiency of the irrigation system and operation. Data developed by DWR's mobile irrigation laboratories show that the state-wide average landscape irrigation system has a distribution uniformity (one measure of irrigation efficiency: how evenly water is distributed over a given area) of about 50%. While distribution uniformity is more important for lawns than most other landscape plants, it is an indication that improvements could be made in this area. Surface runoff, because of poor percolation, high application rates, and sloping surfaces, contributes greatly to poor efficiency. Improvements in how water is applied can result in water savings without affecting the landscape water needs.

Thus, to determine landscape water needs, the following formula can be used:

$$\text{Landscape water needs} = (\text{ET}_o * \text{area} * \text{plant factor}) / \text{irrigation efficiency}$$

This formula can be converted to a percentage of ET_o , or an ET_o factor. These factors are used to estimate landscape water use by multiplying the factor times the ET_o for the region (for example, if an ET_o is 4 acre-feet per acre, but irrigation efficiency is poor, the water applied to the landscaping may be as much as 1.2 times ET_o .)

Estimating Landscape Conservation Potential

DWR estimates that on average, state-wide residential landscaping is currently irrigated at 1.2 times ET_o . However, limited data are available to support this estimate.

To better address this unknown, the CALFED Program has assumed a distribution of landscape acreage over a range of ET_o factors. Since many residential customers have adopted landscape conservation measures, including changes in irrigation systems and operations as well as changes in landscape type, this distribution should more realistically reflect current conditions. Each region's landscaped area has been distributed for:

- A baseline condition
- The No Action Alternative condition
- The CALFED alternative condition

These are shown in detail in Attachment B and summarized in the regional discussions later in this document. To the extent possible, local climate, combined with assumed traditional attitudes toward landscaping, were considered for each region's acreage distribution.

Existing landscaped acreage was distributed differently than the increment of new landscape acreage assumed to be planted by 2020. For example, it is less likely that existing landscapes will be dramatically changed from their current configurations (what is primarily lawn now probably will remain lawn). However, new acreage could be planted with lower ET in mind, such as planting less lawn area, planting more Mediterranean-style landscape, or using xeriscape. As shown in Attachment B, the resulting distributions vary for each urban region.

Separating Aspects of Landscape Conservation Potential

CALFED has assumed a distinction between reduction of losses through irrigation improvements and reduction in landscape ET, using the following criteria:

- Any reduction in ET_0 factor that is above or inclusive of 0.8 assumes reduction in losses that were attributable to irrigation (such as reducing surface runoff to gutters). ET_0 values of 0.8 and above do not assume any change in the type of traditional lawn-oriented landscapes, whether existing or to be planted by 2020. Some fraction of this savings could include reduced evaporative losses associated with landscape irrigation.
- Any reduction below 0.8 is assumed to represent a change to or new planting of Mediterranean, xeriscape, or other landscaping with lower ET than traditional lawn landscaping. These savings are not attributed to irrigation system improvements.

For example, a change from a factor of 1.2 to an ET_0 factor of 0.6 would assume that the increment of reduction from 1.2 to 0.8 is associated with reducing the losses from inefficient irrigation. The additional change from 0.8 to 0.6 would reflect a reduction in the ET of the landscape. Depending on the region, some or all of the initial reduction (that associated with irrigation system improvements) would be considered irrecoverable (see discussion of real water savings versus applied water reduction in Section 5.5 below). For example, if the runoff to the street from inefficient irrigation flowed directly to the Pacific Ocean, it would represent an irrecoverable loss reduction. If, however, the runoff flowed back to a river that was a source to downstream users, the reduction would constitute a reduction in applied water. In either case, the reduction in ET in this example would constitute a reduction in irrecoverable losses.

Baseline Urban Landscape Water Use

For each region, the landscape acreage is distributed among a range of ET_0 factors, accounting for local considerations such as climate, historical landscaping trends, and public perception regarding landscaping. For example, for the South Coast Region, it is assumed that existing acreage is spread between ET_0 factors of 1.2 down to and including 0.6. This amount assumes that some landscapes in this region are already planted in a Mediterranean or xeriscape style. All of the acreage for Sacramento, on the other hand, is assumed to have an ET_0 of 1.2 under existing conditions. **The acreage distribution for each region is presented under the regional descriptions later in this section.** Attachment B contains tables that detail the assumptions and calculations.

To allow a comparison between the No Action Alternative and CALFED conditions, the same distribution of existing acreage was assumed for the future 2020 acreage. This created a baseline condition with which to compare savings from the No Action Alternative and CALFED conditions. For example, the Tulare Lake Region is assumed to currently include approximately 7,000 acres of urban landscaping. This amount is projected to increase to 130,000 acres by 2020. The distribution for the current acreage assumes that 15% is at a factor of 1.2 ET_0 , 60% is at 1.0, and 25% is at 0.8. The future baseline condition assumes the same distribution for the 130,000 acres. This assumption allows for savings potential to be estimated as the projected 130,000 is redistributed as a result of expected efficiency improvements.

Projected Conservation under the No Action Alternative

The existing and future acreage were kept separate to allow different distributions to be made. No Action Alternative conditions assume that some improvements to irrigation are made for the assumed existing landscaped acreage. In addition, a small percentage of the existing landscaped area is assumed to be modified to lower-water-using landscapes. For example, using the Tulare Lake Region's 70,000 acres of existing landscape, increasing to 130,000 by 2020, the 70,000 acres is redistributed from the baseline assumption of 15%, 60%, 25% to a new pattern of 10%, 60%, 30% (see Attachment B). The acreage expected in the future (130,000 acres minus 70,000 existing; or 60,000 acres) is distributed as 10%, 30%, 60%. These two distributions are combined for a regional No Action Alternative distribution of 10%, 46%, 44% for ET₀ factors 1.2, 1.0, and 0.8, respectively.

Estimates for new acreage, land that will be developed as population grows and new houses are built, assume that more efficient irrigation systems will be installed and greater amounts of lower-water-using landscape will be planted, when compared to expected changes to existing landscapes. For example, local landscape ordinances could be adopted that would result in more Mediterranean, or other landscapes conducive to the local climate, to be installed for all new housing instead of typical lawn-intensive landscapes. However, existing acreage would be slow to transition to these new landscape configurations. The distribution of acreage across the various ET₀ factors is shown for each region below under the regional discussions and in Attachment B.

Additional Conservation as a Result of the CALFED Program

The Water Use Efficiency Program is assumed to result in even greater changes to landscape irrigation and plant types than envisioned under the No Action Alternative condition. These changes would occur through technical, planning, and financial support along with a more concerted effort, through urban agency certification, to implement cost-effective conservation measures.

For purposes of estimating potential incremental savings above the No Action Alternative condition, a third distribution of acreage among ET₀ factors was made, both for existing acreage amounts and additional acreage expected to be planted. These distributions simply shifted more acreage lower on the range of ET₀ factors compared to the No Action Alternative condition. Most of the distributions at this level were based on professional judgement. The incremental difference between the No Action Alternative distribution and the CALFED distribution is used to drive the conservation calculations.

5.4.3 INTERIOR COMMERCIAL, INDUSTRIAL, AND INSTITUTIONAL CONSERVATION

Statewide, the commercial, industrial, and institutional sectors, collectively referred to as CII, represent about 30% of the total per-capita daily use, on average. The actual amount of use, can vary significantly for each local water supplier, depending on the quantity of commercial and industrial use, and demand compared with other sector demands. For example, industry may be the predominant user for a particular water supplier, with little or no residential connections in the area. On the other hand, residential use may comprise the majority of a supplier's demands, with very little commercial or industrial uses. To estimate potential CII conservation, CALFED has assumed that the regional CII percentages shown in Table 5-5 represent the portion of this sector's urban demand. These values can be used only to represent a region and do not necessarily represent the variation that can occur when comparing water suppliers.

Table 5-5. Assumed Baseline Commercial, Industrial, and Institutional Percentage of Urban Per-Capita Use

REGION ¹	1995 CII PERCENTAGE	2020 ASSUMED CII BASELINE PERCENTAGE
Sacramento River	35	36
Eastside San Joaquin River	24	25
Tulare Lake	24	25
San Francisco Bay	38	38
Central Coast	30	30
South Coast	32	32
Colorado River	27	28

Note:

Values were obtained from DWR 1997.

¹ Refer to Chapter 3 for information regarding the PSAs that comprise each CALFED region.

Commercial customers generally are defined as water users that provide or distribute a product or service, such as hotels, restaurants, office buildings, commercial business, and other places of commerce. Industrial users can vary from low-water-using industries, such as clothing manufacturing, to high-water-use industries, such as food processing or the semi-conductor industry. Institutional users include establishments dedicated to public service, such as schools, courts, churches, hospitals, and government facilities.

The demand for water from CII customers includes many of the same needs as residential users—toilets, sinks, laundry facilities, and kitchens—but the use is often much greater. CII demand also can come from process water, cooling towers, and large restaurant kitchens, as well as outdoor decorative landscaping. Landscape water use, however, is accounted for under the previous subsection, "Urban Landscape Conservation" and is not included here. The CII conservation estimates discussed in this section primarily focus on improving the efficiency of internal CII water use.

As noted in a recent study, the potential indoor water conservation opportunities for commercial water users ranges from a 20-25.6% reduction from existing use levels, with an average of 22.2 % (EPA 1997). DWR also has stated that the BMPs in the Urban MOU (see discussion earlier in this section) are projected to reduce CII water use by 12-15% by 2020 (DWR 1998). Given this information, it would appear that of the 22% reduction potential noted in the EPA study, approximately one-half to two-thirds of the potential would occur by 2020 under current efforts.

Baseline Commercial, Industrial, and Institutional Water Use

An estimate of projected baseline CII water use that could occur in 2020 is necessary to estimate potential conservation savings under the No Action and CALFED Program Alternatives, respectively. Per-capita water use values assumed to occur in 2020 as a result of population increases and economic influences, coupled with expected urban BMP implementation, were used (see Table 5-2 in the column “2020 Urban Demand with Expected Conservation”).

As previously shown in Table 5-5, a portion of each region’s projected per-capita water use value is attributable to CII demand. However, the percentage is not necessarily the same as occurs under 1995 assumed conditions. For example, the Sacramento Region has a 1995 CII demand of 35% of the total per-capita use value. In 20 years, the value may increase as a result of a shift in the make-up of the types of CII users in the region.

In general, **industrial** use is anticipated to continue to decline or stabilize as a result of:

- Increasing environmental constraints regarding wastewater discharge and recycling practices
- More energy- and water-efficient industrial processes and equipment
- A national shift away from a manufacturing economy to a service-oriented economy
- A shift of some industry to out-of-state areas

However, as the state’s population and economy increase, **commercial** water use is expected to increase, although the extent is unknown. To estimate conservation potential, CALFED has assumed that the percentage of per-capita use resulting from commercial activities will increase to a greater extent than industrial use declines. The assumed baseline CII percentages are shown in Table 5-5.

Projected Conservation under the No Action Alternative

Since some CII water saving is inherent in the 2020 per-capita projections, an assumption is necessary to determine what additional savings could occur absent a CALFED Bay-Delta solution. CALFED has assumed that the 2020 per-capita projection with urban BMP implementation achieved half of the conservation potential (one-half of 22%, or 11%). It is assumed that additional CII conservation also could occur beyond the urban BMPs under the No Action Alternative conditions. This additional conservation is assumed to result in another 4% reduction in CII use, bringing the total CII savings under the No Action Alternative to an assumed 15% of existing conditions.

Several other factors besides the CII-related BMPs are believed to result in more efficient water use by this sector by 2020. Some of these factors include:

- The existing trends discussed under baseline conditions.
- Water and wastewater costs probably will increase faster than the rate of inflation to account for infrastructure replacement and population growth, creating an incentive to be more efficient.
- California's industrial and commercial sector will become more efficient with their processes, including water use, to gain or maintain a competitive edge.
- Existing and new businesses will use more efficient equipment as it becomes available.
- Continued state-wide demand for water will continue to bring greater attention to efficient water use practices and present "pressure" to implement conservation measures.

Since the 2020 per-capita values in Table 5-2 are assumed to include much of the 15% assumed conservation potential, additional potential is calculated by reducing the projected 2020 CII demand by only 4%.

To illustrate this, consider:

For the Sacramento Region (using 2020 per-capita with conservation as baseline):

Assume:	2020 per-capita use	=	257 gpcd (see Table 5-2)
	2020 population	=	3,900,000
	2020 CII portion of total	=	36% (see Table 5-5)
	No Action savings	=	4%
Calculations:	Projected CII use	=	404,130 acre-feet
	Projected savings	=	16,160 acre-feet $[404,130 * 4\%]$
	2020 remaining CII use	=	388,000 acre-feet

Another possible method to calculate savings potential would use projected 2020 per-capita values absent conservation as a baseline (Table 5-2). If these values were used, they would need to be reduced by the full 15% to account for both the expected BMP-related savings and additional No Action Alternative reductions.

To compare the results of this methodology, consider:

For the Sacramento Region (using 2020 per-capita without conservation as baseline):

Assume:	2020 per-capita use	=	292 gpcd (see Table 5-2)
	2020 population	=	3,900,000
	2020 CII portion of total	=	36% (see Table 5-5)
	No Action savings	=	15%
Calculations:	Projected CII use	=	459,165 acre-feet
	Projected savings	=	68,875 acre-feet $[459,000 * 15\%]$
	2020 remaining CII use	=	390,000 acre-feet

When the remaining CII use projected for 2020 is compared for each method, the answers are very similar. Thus, whether or not the expected BMP implementation is included in the calculation, the CII demand expected under 2020 conditions is the same.

CALFED has proceeded with its calculations using the 2020 projected per-capita values that already account for BMP savings. This assumption is consistent with the other urban conservation estimates that assume a baseline with conservation has been reached by 2020.

Additional Conservation as a Result of the CALFED Program

As with other components of urban conservation, the CALFED alternative is assumed to result in CII water use savings that reach beyond those estimated under No Action Alternative conditions. Since the No Action Alternative condition was assumed to result in 15% of the 22% goal, the CALFED alternative is expected to achieve another 7% reduction from the 2020 baseline.

It is assumed that these gains can be achieved through implementation of several measures, such as:

- Enlarging the scope of CII water audits to include warehouses, correctional facilities, military bases, utility systems, and passenger terminals (largely ignored under current audit programs).
- Developing incentive programs to obtain consistent, effective data at the water supplier level so they better understand the water needs of their CII customers.
- Developing local programs that offer financial incentives, public recognition, technical information, or water rate adjustments.
- Developing and enforcing local CII water use efficiency ordinances.
- Implementing state and federal programs that offer financial and technical assistance directly to the CII users.

The calculation to determine the potential water conservation as a result of the CALFED Program is similar to that used to determine the No Action Alternative savings. Since the CALFED increment is additive to the No Action Alternative projection, the same baseline must be used.

To illustrate this, consider:

For the Sacramento Region (using 2020 per-capita with conservation as baseline):

Assume:	2020 per-capita use	=	257 gpcd	(see Table 5-2)
	2020 population	=	3,900,000	
	2020 CII portion of total	=	36%	(see Table 5-5)
	CALFED savings	=	7%	
Calculations:	Projected CII use	=	404,130 acre-feet	
	Projected CALFED savings	=	28,290 acre-feet	[404,130 * 7%]
Previously calculated:	No Action savings	=	16,160 acre-feet	
	Combined total savings	=	44,450 acre-feet	(28,290 + 16,160)
	2020 remaining CII use	=	359,680 acre-feet	[404,130-44,450]

Thus, CALFED's incremental savings are assumed to reduce CII use from the same base as the No Action Alternative (i.e., they both calculate savings from the same 2020 per-capita use value). This assumption considers the reality that actions taken by CII users as a result of CALFED will not be independent of actions taken under the No Action Alternative

Depending on each region, a portion of this savings does constitute a reduction in irrecoverable losses and is available for reallocation to other purposes. See the regional discussions later in this section for the specific values.